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PATENT APPLICATION

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I (Name and address of applicant, and, in case of body corporate, place of incorporation)

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(באנגלית)
_ (English) Supplementary Vascular Clamp For The Tool Kit Of The Open Approach Stapler

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מבקשה פטנט from application	לבקשה/לפטנט to Patent/Appl.	מספר/סימן Number/Mark	תאריך Date	מדינה האיגוד Convention Country	
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**SUPPLEMENTARY VASCULAR CLAMP FOR THE TOOL KIT OF
THE OPEN APPROACH STAPLER**

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SUPPLEMENTARY VASCULAR CLAMP FOR THE TOOL KIT OF AN OPEN APPROACH STAPLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to medicine, particularly to clamps used in vascular surgery for occlusion of blood vessels during a surgical operation, such as vascular clamps used in aortic aneurysm repair.

2. Background of the Invention

[0002] Vascular clamps are very important in performing operations on blood vessels. Most often they serve for occlusion of a blood vessel by their jaws or other working members, which allows to temporarily stop the blood flow in the operated portion of this blood vessel. So, there are known vascular clamps disclosed in U.S. Pat. 4,531,519; 5,152,770; 5,282,812.

[0003] Dunn and Scarrow in U.S. Pat. 4,531,519 disclose a vascular clamp in the form of a tapering, flexible and tubular envelope which is wound around the blood vessel to be occluded and is inflated by air or another fluid.

[0004] Bengmark and Persson in U.S. Pat. 5,152,770 describe a similar device, which includes a flexible, elongate strip covered on its one side with a plurality of communicating bulbs. The strip is wound around the blood vessel or duct to be occluded and the bulbs are inflated to a pressure serving to occlude the duct. After deflation of the bulbs the strip is removed to allow the duct to re-open. As in previous vascular clamp, the application of the strip or envelope by winding it around the blood vessel and subsequently inflating it until the flow of blood or other body fluid is stopped, is a difficult and time consuming task. For this reason both devices are used in exceptional cases only.

[0005] Suarez in U.S. Pat. 5,282,812 discloses a vascular clamp in the form of a strip of metal bent into V-shape with its inside surfaces lined with a resilient material. Closing of a vessel is described, whereby the clamp is to be held in a forceps, to be pushed over the vessel to be occluded and pressed onto the vessel, whereupon the forceps is removed. The material of the strip is supposed to keep its shape after removal of the forceps and to maintain the necessary pressure during the operation. The device is provided with means for engaging the forceps jaws after completed surgery for opening the V and for removing the clamp. It is claimed that the strip material would have a positional memory for exerting the necessary pressure after positioning. This would require a different size and material of the device for every size of vessel and blood pressure.

[0006] Most of the known vascular clamps have two intersecting arms mounted on a common pivot and provided with clamping jaws at their first ends, as well as with fixing grips at their second ends. Among these are vascular clamps described in Canadian Pat. 1103119 and U.S. Pat. 5,624,454.

[0007] Muermans and Rivlin in Canadian Patent 1103119 disclose a surgical clamp having two clamping jaws and comprising a soft pad placed over each jaw. Each pad includes two cavities, one of them tightly located over the

respective jaw, the second cavity is filled with a fluid or solid and is subsequently sealed. It is claimed that the device clamps the vessel without damage.

[0008] Devices described in U.S. Pat. 3,503,398 and 5,236,437 also have soft members on the inner surface of their clamping jaws to prevent damaging of blood vessel surface. These soft members are adapted to be filled with liquid or gas, see U.S. Pat. 5,236,437.

[0009] All aforesaid devices serve to cut off a portion of the blood vessel during a surgical operation to prevent the flow of blood over this portion.

[0010] Closest to the claimed invention is the "Padded vascular clamp" described in U.S. Pat. 5,624,454. Palti and Schnall in U.S. Pat. 5,624,454 disclose a vascular clamp for occluding a blood vessel or duct in a human or animal. The vascular clamp includes a pair of pivoting arms with a clamping jaw rigidly attached to a distal end of each pivoting arm. A concave substantially semi-cylindrical chamber is formed in each clamping jaw. The clamping jaws are movable between an open position and a closed position, and are aligned so as to form a substantially cylindrical chamber in the closed position. A balloon is mounted in the concave semi-cylindrical chamber of each clamping jaw. Each balloon includes a substantially semi-cylindrical

rigid shell conforming to the concave semi-cylindrical chamber and a thin, elastic material pre-filled with a liquid or gaseous fluid at a predetermined pressure. The balloons are configured to completely surround and occlude the blood vessel or duct in the closed position of the vascular clamp. The rigid shell of each balloon is attached to its associated clamping jaw.

[0011] The distinction of this vascular clamp is that its design allows to adjust within a wide range the rate of occlusion of a blood vessel—from simple occlusion of this blood vessel to a complete closure of its lumen.

[0012] The suggested vascular clamp has a function different from that of known vascular clamps. It serves to clamp the outer surface of a blood vessel during a surgical operation when a special endovascular stapler for suturing a prosthesis - graft or stent-graft to the wall of a blood vessel, substantially the aorta, in direction from inside to outside via metal staples, is inserted within the blood vessel. Thus the development of the suggested vascular clamp pursues other goals.

[0013] An object of the present invention is to provide intraaortal bending of the ends of staples emerging from an open approach endovascular stapler during a surgical procedure for suturing a prosthesis— graft or stent-graft to the wall of a blood vessel, substantially the aorta.

[0014] Another object of the present invention is a secure enclosure of aorta walls by clamping jaws of the claimed vascular clamp to close the possible clearance between the inner surface of clamping jaws and outer surface of the aorta, and prevent at the same time damage of the outer surface of the aorta walls.

[0015] Still another object of the present invention is a correction of irregularity in thickness of the aorta walls when applying the claimed vascular clamp.

SUMMARY OF THE INVENTION

[0016] The subject-matter of the present invention is a supplementary vascular clamp for the tool kit of an open approach stapler serving for occlusion of a blood vessel around this open approach stapler when the latter comes into action.

[0017] The vascular clamp comprises: a) a pair of pivoting arms, b) a compensating means for the correction of irregularity in aorta wall thickness, c) a first sealing means for secure enclosure of aorta walls by the clamping jaws, d) a second sealing means for secure enclosure of aorta walls by the

clamping jaws and, finally, e) a means for uniform ejection of staples over the hole inner surface of clamping jaws.

[0018] Each of pivoting arms in the claimed vascular clamp has a proximal end a distal handle end. Each pivoting arm contains a clamping jaw rigidly attached to a respective proximal end of this arm and shaped as a concave semi-oval cavity. Clamping jaws are configured to move between the open position and closed position, the clamping jaws defining a through oval cavity in their closed position.

[0019] The pivoting arms cross one another and connected by a pivot at the point of their intersection near their proximal ends. The pivoting arms contain fixing grips near their distal handle ends.

[0020] Each clamping jaw of the vascular clamp is shaped as a semi-oval cavity having a concave inner surface and curved outer surface. The clamping jaws are adapted to be rigidly attached to the proximal ends of pivoting arms of conventional vascular clamps.

[0021] The compensating means for correction of the irregularity in thickness of aorta walls contains clamping jaws with concave semi-oval inner surfaces. Clamping jaws are capable of movement between the open position and

closed position, defining in closed position a through oval cavity with the long axis of symmetry coinciding with the parting plane of these clamping jaws.

[0022] The first sealing means for secure enclosure of aorta walls is formed as clamping jaws shaped as concave semi-oval cavities. These clamping jaws overlap one another so that the ends of one of the clamping jaws is female, and the ends of the second of clamping jaws – male.

[0023] The second sealing means for secure enclosure of aorta walls is formed as clamping jaws shaped as concave semi-oval cavities the ends whereof facing and overlapping one another are flexible.

[0024] The means for providing regular ejection of staples over the whole inner surface of prosthesis attachment to the aorta is formed as clamping jaws shaped as semi-oval cavities, the ends whereof facing and overlapping one another are disposed with a clearance between them.

[0025] The means for providing regular ejection of staples over the whole inner surface of prosthesis attachment to the aorta is formed as clamping jaws shaped as concave semi-oval cavities, the ends whereof facing and overlapping one another are disposed with a clearance of 0,3 mm between them.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The invention will now be described in conjunction with the following drawings in which like reference numerals designate like elements and wherein:

[0027] FIG. 1 is a perspective view of a supplementary vascular clamp according the first embodiment of the present invention;

[0028] FIG. 2 shows the distal ends of pivoting arms with handles and fixing grips;

[0029] FIG. 3, 4 show the working part of the claimed vascular clamp in closed position;

[0030] FIG. 5, 6 show two views of a male clamping jaw;

[0031] FIG. 7, 8 show the working part of the claimed vascular clamp in a partly open and in a partly closed position;

[0032] FIG. 9 shows a diagram of the working part of the claimed vascular clamp in open position.

DETAILED DESCRIPTION OF THE DRAWINGS

[0033] The preferred embodiments of the present invention are described below. The inventors of the present subject matter contemplate that the embodiment described herein is capable of use in the repair of other vessels

and in other procedures. Thus, it is intended that the present invention cover the modifications and variations of the invention, provided they come within the scope of the appended claims and their equivalents.

[0034] The most preferred embodiments of a supplementary vascular clamp, according to the present invention, are shown in drawing figures 1 - 9.

[0035] Claimed supplementary vascular clamp 1 (FIG. 1) comprises a pair of pivoting arms 10 and 12. Each of the pivoting arms 10 and 12 has a proximal end, 14 and 16 respectively, distal handle end, 18 and 20 respectively. Each pivoting arm contains a clamping jaw, 22 and 24 respectively, rigidly attached to a respective proximal end, 14 or 16 of this arm 10 or 12 and shaped as a concave semi-oval cavity. Clamping jaws 22 and 24 are movable between open position (FIG. 8) and closed position (FIG. 1). Clamping jaws 22 and 24 define in closed position a through oval cavity 26 (FIG. 1).

[0036] Pivoting arms 10 and 12 cross one another and are connected by a pivot 28 at the point of their intersection near their proximal ends 14 and 16 (FIG. 1). Pivoting arms 10 and 12 contain fixing grips 30 and 32 near their distal handle ends 18 and 20 (FIG. 2).

[0037] Each clamping jaw 22 and 24 of vascular clamp 1 (FIG. 3) is shaped as a concave semi-oval cavity having a concave inner surface, 34 and 36 respectively, and a curved outer surface, 38 and 40 respectively. Clamping jaws 22 and 24 are capable of being rigidly attached to proximal ends 14 and 16 of pivoting arms 10 and 12 of conventional vascular clamps (FIG. 1, 3).

[0038] The claimed supplementary vascular clamp 1 also comprises a compensating means for correction of irregularity in thickness of the aorta wall (FIG.1). This compensating means comprises clamping jaws 22, 24 with concave semi-oval inner surfaces 34, 36. Clamping jaws 22, 24 are adapted to move between open position and closed position (FIG. 3, 1). Therewith they define in closed position a through oval cavity 26, the long axis of symmetry thereof 42 coincides with the parting plane of these clamping jaws 22, 24, and the short axis of symmetry 44 is perpendicular to this parting plane (FIG. 4).

[0039] Vascular clamp 1 further contains a first means for providing secure enclosure of aorta walls including clamping jaws 22, 24 (FIG. 4) shaped as concave semi-oval cavities and overlapping one another. These clamping jaws 22, 24 overlap one another by their ends in such a way, that ends 46, 48 of one of the clamping jaws, in this case, clamping jaw 22 are male, and ends 50, 52 of the other of the clamping jaws, in this case, clamping jaw 24 – female.

[0040] The second sealing means for providing secure enclosure of aorta wall contains clamping jaws 22, 24 shaped as concave semi-oval cavities, the ends whereof, 46, 48 and 50, 52 respectively, facing and overlapping one another are flexible (FIG. 7).

[0041] Vascular clamp 1 is also provided with a means for providing regular ejection of staples over the whole inner surface prosthesis attachment to the aorta. This means is a clearance between the ends of clamping jaws 22, 24. The ends of clamping jaws 22 and 24 facing and overlapping one another, 46 and 50, 48 and 52 respectively are disposed with clearances between them (FIG. 8). These clearances A and B may amount to about 0,3 mm (FIG. 9).

[0042] The claimed device operates as follows.

[0043] During a surgical operation, the aorta or another blood vessel is exposed. Within this blood vessel there is inserted in particular a prosthesis such as a graft or stent-graft, as well as a tool for securing this prosthesis to the blood vessel wall, such as an open approach stapler. Then an supplementary vascular clamp is applied onto the outer surface of this blood vessel. When applying vascular clamp 1 its proximal ends 14 and 16 with clamping jaws 22 and 24 are located on both sides of the operated blood vessel. Thereupon, due to forces applied to distal ends with handles 18 and 20, arms 10 and 12 turn about axis 28 to bring together clamping jaws 22 and 24. Clamping jaws 22 and 24 define in their closed position a through oval cavity 26 enclosing the blood vessel. Therewith it is attempted to place supplementary vascular clamp 1 in such a way that it is located by its clamping jaws 22 and 24 concentrically with the actuator of an open approach stapler in the area of ejection of its staples. Then the position of vascular clamp 1 is fixed by fixing grips 30 and 32, selecting such a position of their mutual attachment, which would provide tight occlusion of the outer surface of a blood vessel by clamping jaws 22 and 24.

[0044] Then the open approach stapler is actuated to suture by staples the prosthesis to the inner surface of the blood vessel (not shown in the drawings). When the open approach stapler comes into action, the first and second sealing means of supplementary vascular clamp 1, containing

flexible, overlapping one another ends 46 and 50, 48 and 52 of clamping jaws 22 and 24 tightly enclose the outer surface of the blood vessel to prevent damage thereto and simultaneously providing the designed bending of the ends of staples of this stapler. The compensating means shaped as an oval cavity 26 provides correction of irregularity in thickness of the walls of an operated blood vessel, such as the aorta, which is achieved by the aorta redistribution over the entire oval section 26 of clamp 1.

[0045] The claimed supplementary vascular clamp is developed as a device comprised in the tool kit for an open approach stapler. At the same time this clamp may be used for work with other endovascular staplers. The suggested clamp may be as well used for work with other tools applied in particular for cavitory operations, such as operations on the bowels.

[0046] While this invention has been described in conjunction with specific embodiment thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth herein are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the invention as defined in the following claims.

CLAIMS

1. A supplementary vascular clamp for the tool kit of an open approach stapler serving to occlude a blood vessel around this open approach stapler at the moment it is actuated, comprising:

- a) a pair of pivoting arms each whereof having a proximal end and distal handle end; each pivoting arm contains a clamping jaw rigidly attached to a respective proximal end of this arm and shaped as a concave semi-oval cavity, said clamping jaws being movable between open position and closed position, said clamping jaws defining a through oval cavity in closed position;
- b) a compensating means for correction of irregularity in thickness of aorta walls;
- c) a first sealing means for providing secure enclosure of aorta walls by clamping jaws;
- d) a second sealing means for providing secure enclosure of aorta walls by clamping jaws;
- e) a means for providing regular ejection of staples over the entire inner surface of clamping jaws,

whereby there are provided a regular intraaortal bending of the ends of staples of open approach stapler, secure enclosure of aorta walls by clamping jaws as well as correction of irregularity in thickness of aorta walls .

2. A supplementary vascular clamp according to claim 1, wherein said pivoting arms cross one another and joined together via a pivot at the point of their intersection, the pivoting arms containing fixing grips near their distal handle ends.
3. A supplementary vascular clamp according to claim 1, wherein said pivoting arms cross one another and are joined together via a pivot near their proximal ends.
4. A supplementary vascular clamp according to claim 1, wherein each said clamping jaw is shaped as a concave semi-oval cavity having a concave inner surface and curved outer surface.
5. A supplementary vascular clamp according to claim 1, wherein the clamping jaws are configured to be rigidly attached to the proximal ends of pivoting arms of conventional vascular clamps.
6. A supplementary vascular clamp according to claim 1, wherein said compensating means for correction of irregularity in thickness of aorta walls contains clamping jaws with concave semi-oval inner surfaces movable between open position and closed position, the clamping jaws defining, in

closed position, a through oval cavity and the long axis of symmetry of said cavity coincides with the parting plane of clamping jaws.

7. A supplementary vascular clamp according to claim 1, wherein said first sealing means for providing secure enclosure of aorta walls contains clamping jaws shaped as concave semi-oval cavities overlapping one another by their ends in such a way, that the ends of one of the clamping jaws are female, and the ends of the other of clamping jaws - male.

8. A supplementary vascular clamp according to claim 7, wherein said second sealing means for providing secure enclosure of aorta walls contains clamping jaws shaped as concave semi-oval cavities, the ends whereof facing and overlapping one another are flexible.

9. A supplementary vascular clamp according to claim 8, wherein said means for providing regular ejection of staples over the whole surface of prosthesis attachment to the aorta contains clamping jaws shaped as concave semi-oval cavities, the ends whereof, facing and overlapping one another have a clearance between them.

10. A supplementary vascular clamp according to claim 9, wherein said means for providing regular ejection of staples over the whole inner surface of prosthesis attachment to the aorta contains clamping jaws shaped as concave semi-oval cavities, the ends whereof, facing and overlapping one another, have a clearance between them which amounts to about 0.3 mm.

ABSTRACT

The present invention relates to medicine, in particular, to clamps used in vascular surgery for occlusion of blood vessels during a surgical operation, such as vascular clamps used in aortic aneurysm repair. The claimed supplementary vascular clamp comprises a pair of pivoting arms, each of them having a proximal end and a distal handle end. Each pivoting arm contains clamping jaws rigidly attached to a respective proximal end of this arm and shaped as a concave semi-oval cavity. The clamping jaws are movable between the open position and closed position. The clamping jaws define a through oval cavity in their closed position. The vascular clamp is further provided with a compensating means for correction of irregularity in wall thickness of the aorta, a first and a second sealing means for providing secure enclosure of aorta walls, as well as a means for providing regular ejection of staples.

10 Claims, 9 Drawing Figures

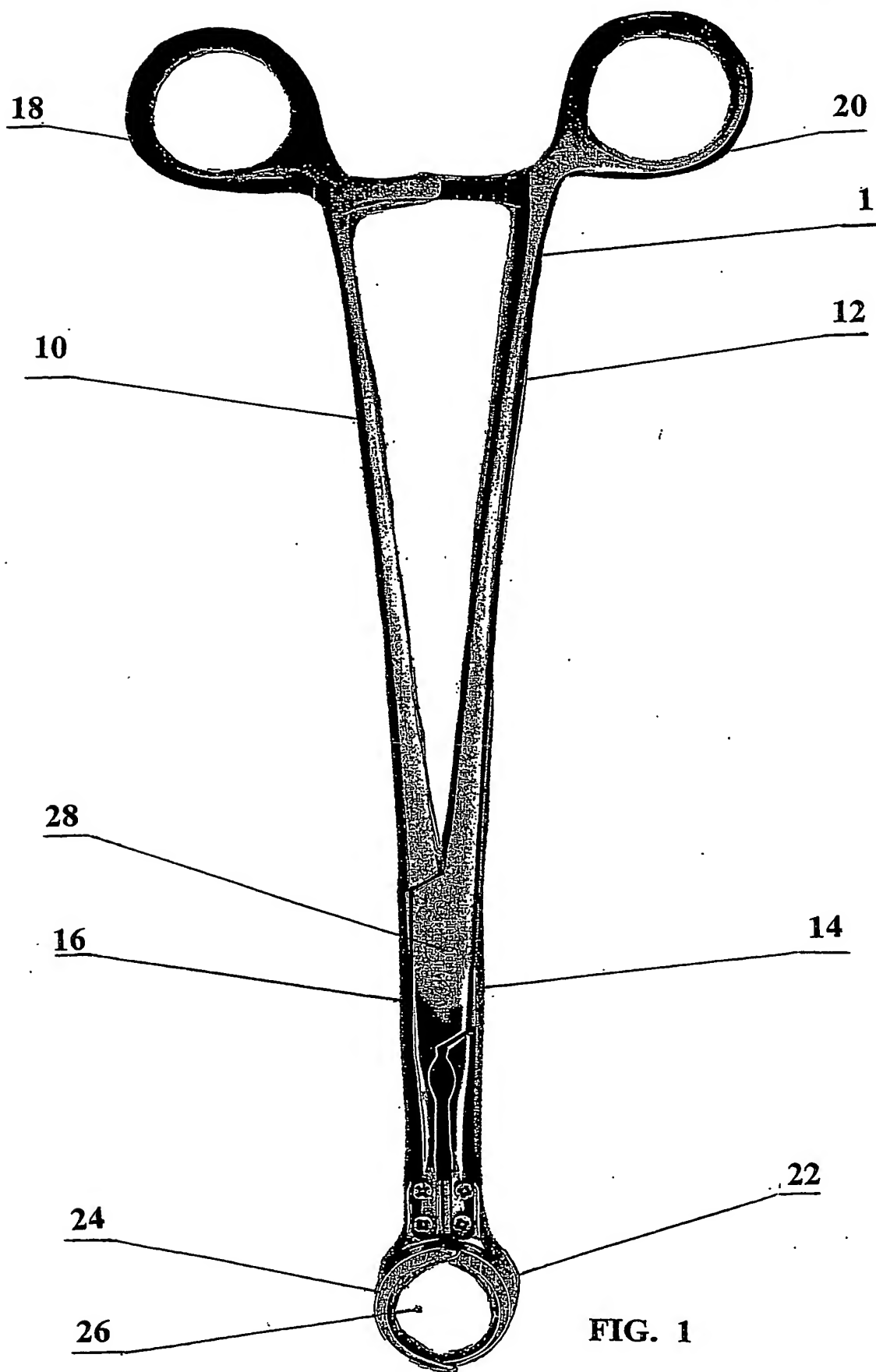


FIG. 1

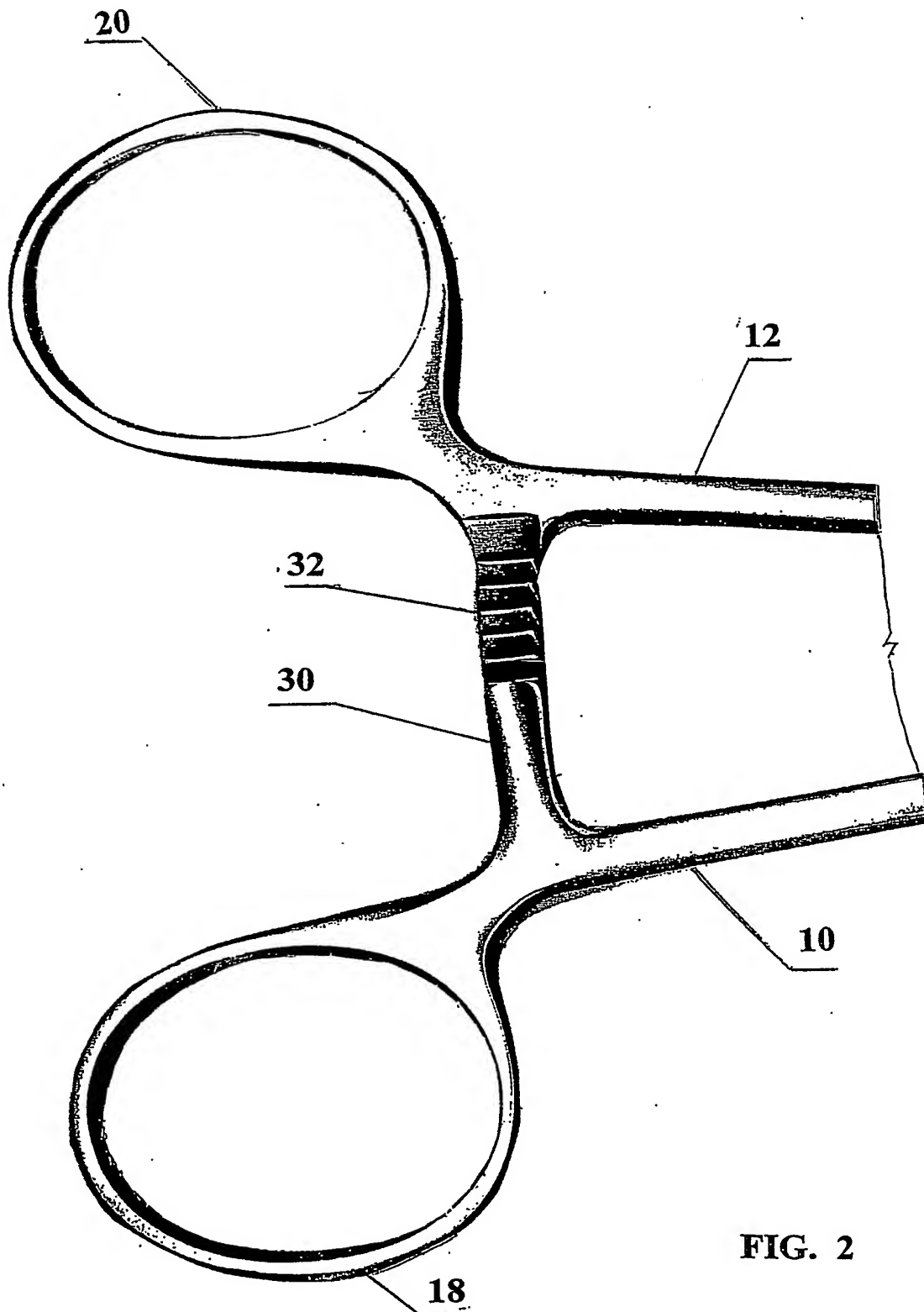


FIG. 2

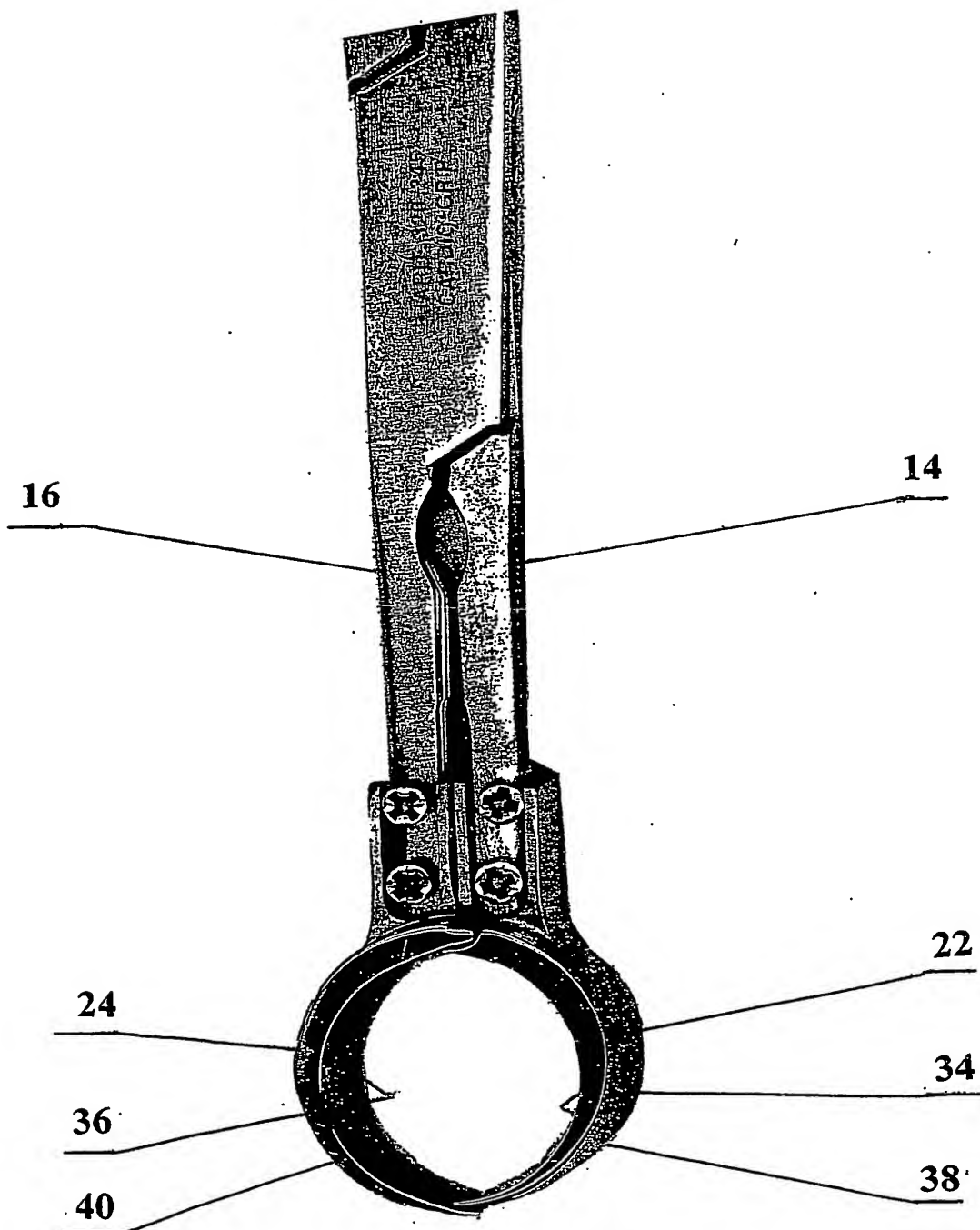


FIG. 3

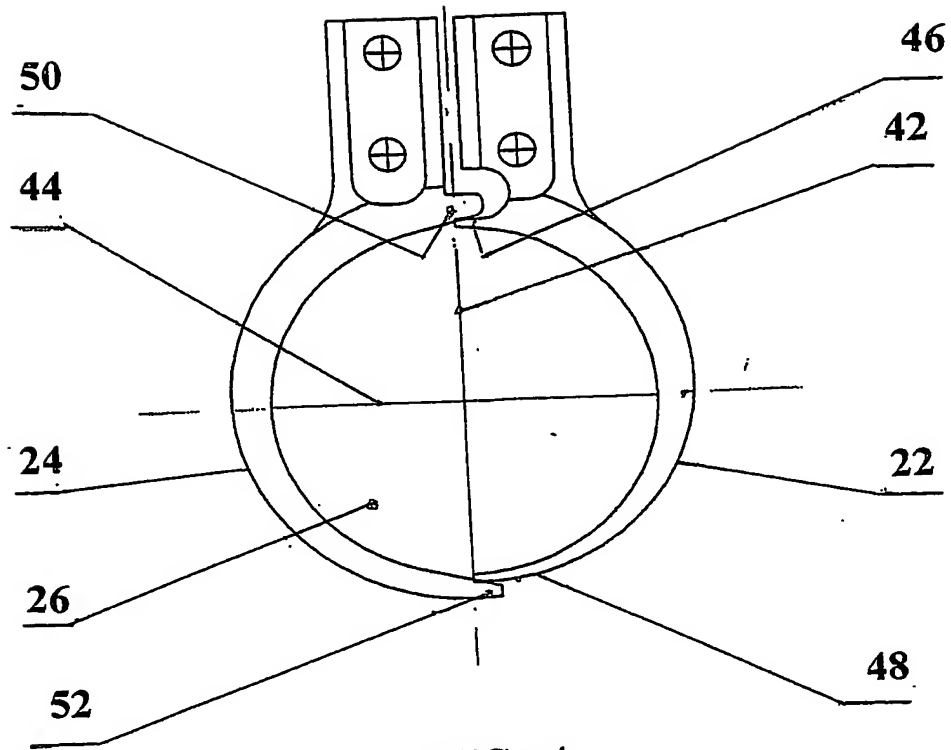


FIG. 4

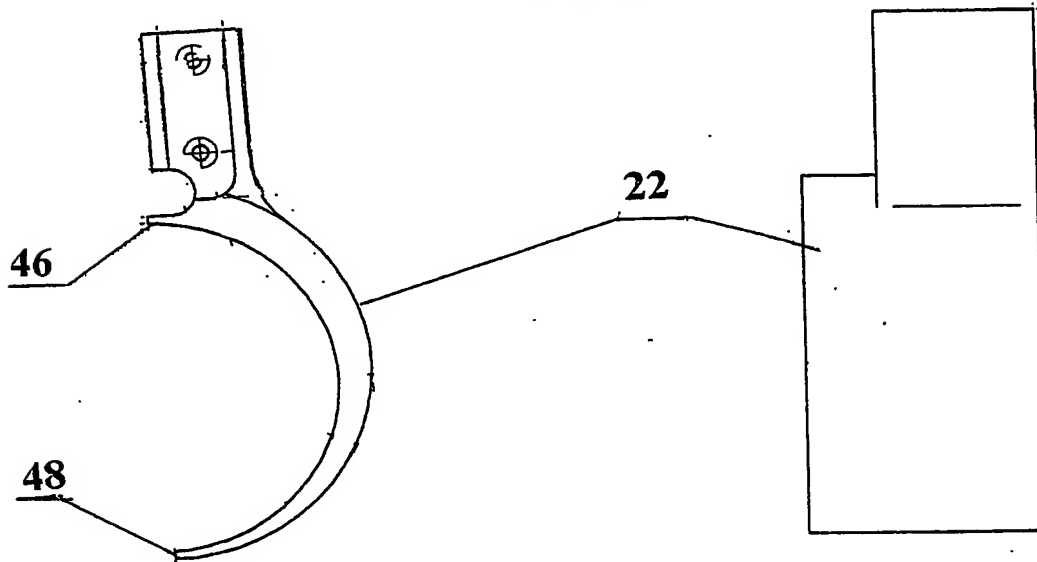


FIG. 5

FIG. 6

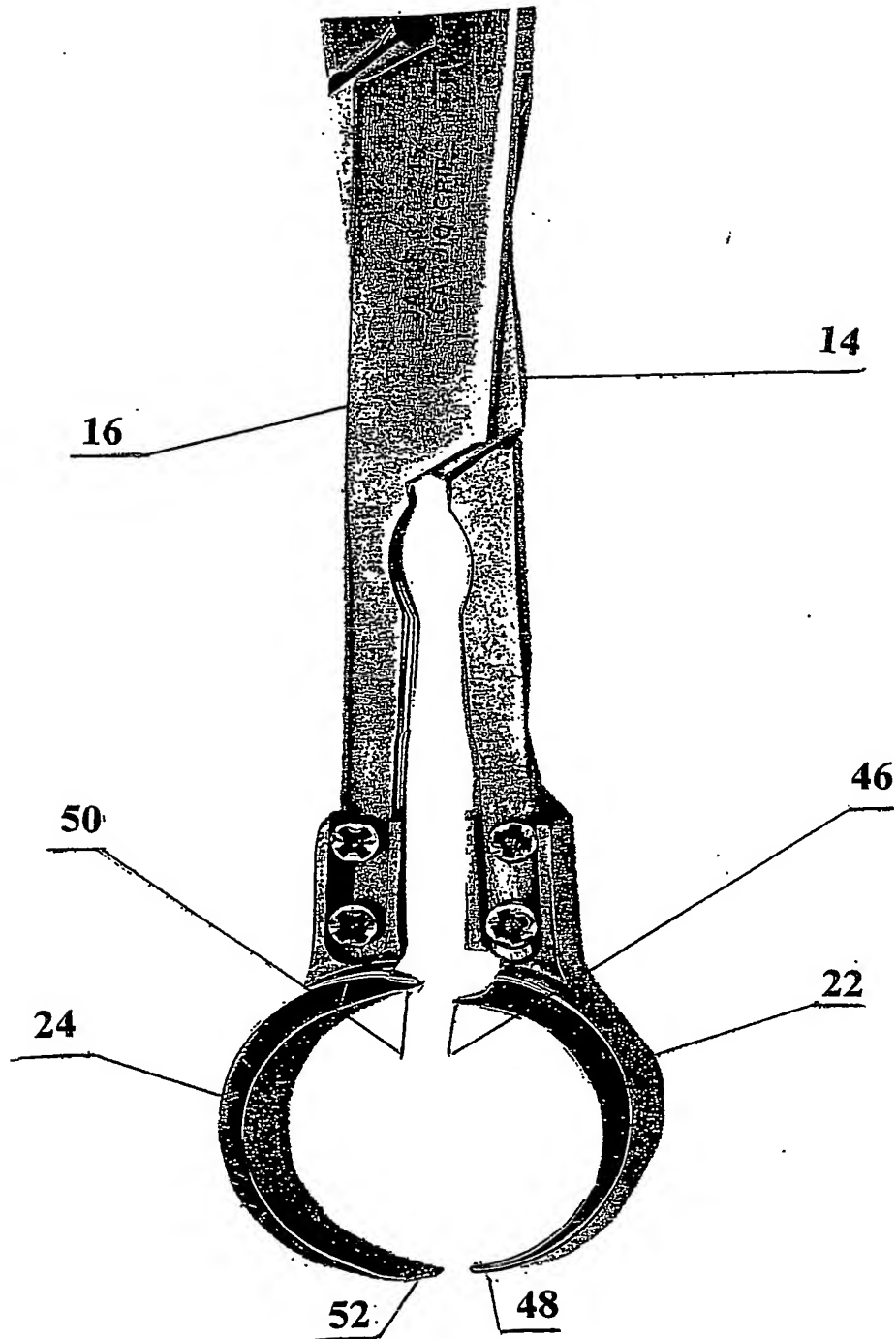


FIG. 7

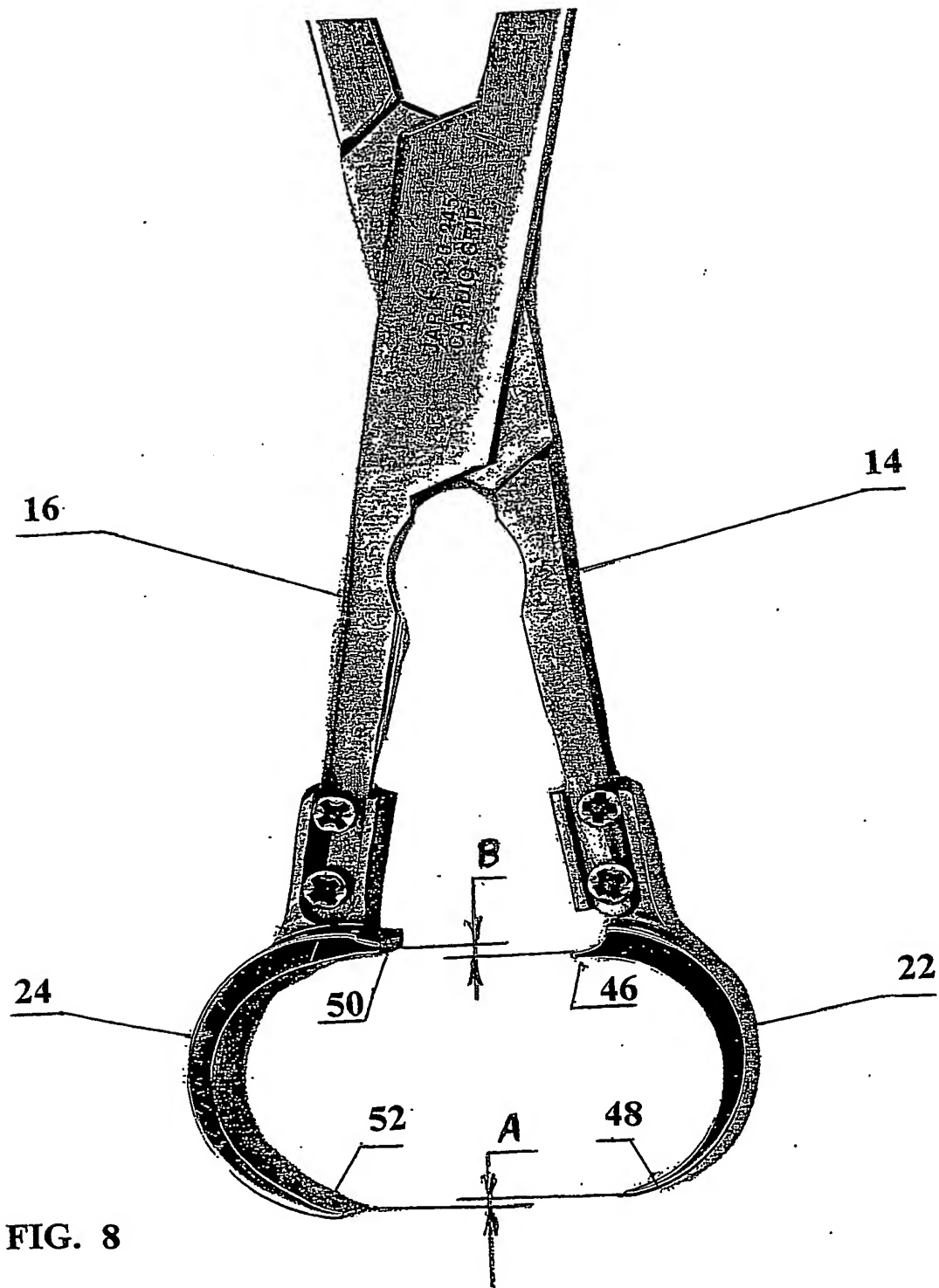


FIG. 8

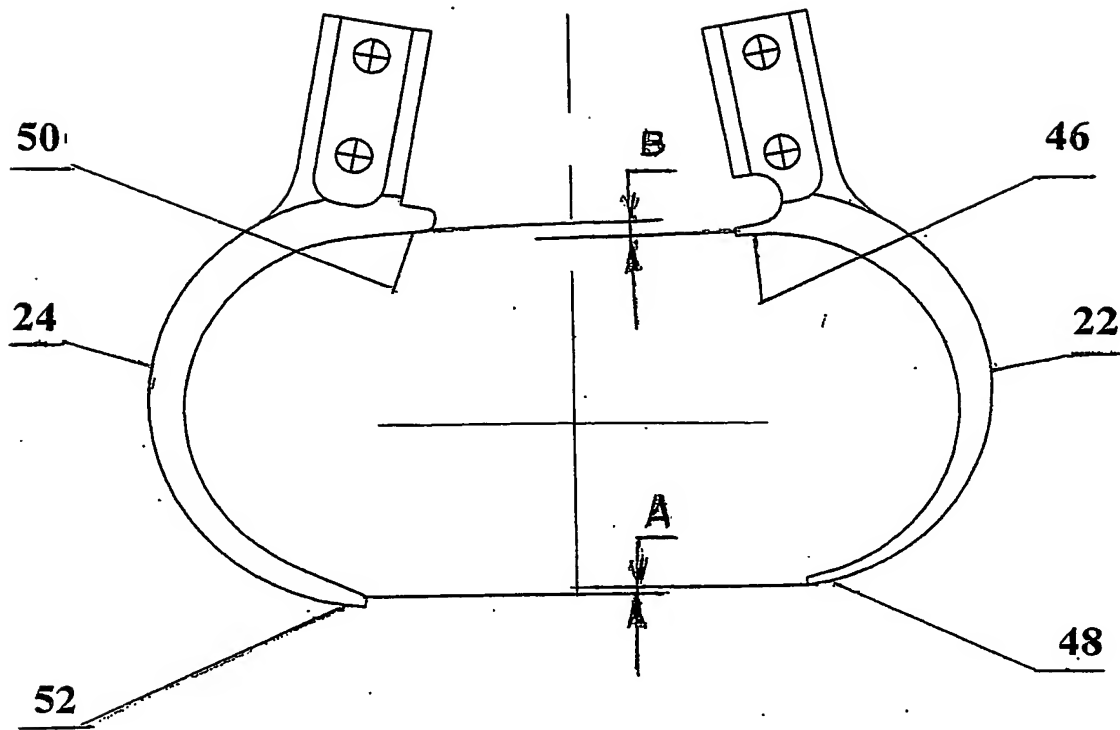


FIG. 9

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